The Science Teacher

VOLUME VI FEBRUARY, 1939 NUMBER I

PERIODIC TABLE OF THE 92 ELEMENTS
AN EXHIBIT IN THE MUSEUM OF SCIENCE AND INDUSTRY, CHICAGO

IN THIS ISSUE----

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The Science Teacher

VOLUME VI FEBRUARY, 1939 NUMBER I

Bacteriology in High School Biology

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(Delivered before the Illinois Biology Teachers Association, November 4, 1938, Urbana, Ill.)

Were the speaker to adhere strictly to the title which has been given him, his remarks would take little more than three or four minutes. During the years of his own active interest in science, he has seen the constant effort to put into the high school curriculum subjects which had heretofore been taught only in college. Whether this is good is determined largely by the purpose of the high school course, whether it should prepare the student for college or for life on the assumption that he will never go to college. Which course a student will need cannot be predicted for we cannot always know what the future of a high school student will be. One safe procedure would be to offer two courses in high school, one which would prepare for college entrance and another for preparation for earning a livelihood. These courses might even be offered in different high schools, the latter in schools quite like the trade-schools or "institutes" in certain of our cities. The vocational courses have been introduced into some high schools for teaching more practical things. Some graduates of our high-schools are doing bacteriological work as technicians in hospitals and in city and state laboratories. They are doing such work under supervision of better-trained individuals. Whether this will always be possible in the future will depend on what standards are adopted in the future for such work.

Before attacking the subject which has been given me, something should be said about the study of science in general. Owing to the fact that better opportunities for earning a livelihood seem to offer themselves in science, a continued trend toward science is apparent. Science courses in colleges are well filled with students. Whether this is desirable cannot be determined by consideration of the mass as a whole but by weighing the situation for each individual student. This would be difficult. It is quite obvious that the opportunities for earning a living in science may become as difficult in the future as they have been in other fields for several years. Dr. Ralph Gerard of the Physiology Department of the University of Chicago has recently said that education has two major aspects: **utilitarian**, vocational training to enable one to live effectively in society, **to do**; and **esthetic**, avocational training to enable one to live with himself, **to be**. Study of a science such as bacteriology may be related to the first aspect, **to do**, although it concerns the second if one is not studying it to earn a livelihood. Certainly an individual who, through training in bacteriology, knows how to select clean foods, and avoid infection, can live more effectively even though he may not be engaged in professional work in bacteriology. The science does help to make life safer, at least.

A definite conclusion reached after some twenty-five years as a teacher of bacteriology is that students of science are quite prone to neglect training which

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will help them to live and **be**; they are too interested in learning to **do** something. If studying to be chemists, they take too much chemistry or to be bacteriologists, too much bacteriology. The speaker was interested to hear an employer who hired young chemists just out of college say that most of them came to him with too much chemistry. He did not mean this literally, of course, but believed that these young men should have taken more time to browse in libraries, to have attended lectures in economics, history and political science and to have become more proficient in written English. This situation is causing some concern among those who are responsible for the training of young men in certain of the applied sciences.

One opportunity for high-school teachers to have a more effective part in preparing students for college as well as for life, is to emphasize the study of the modern languages, French and German in particular. These languages are needed in college by advanced students in the sciences. Unless a student can read French and German, a vast literature is closed to him. In graduate study, reading knowledge of these languages is absolutely necessary—so necessary in fact that graduate students are required to demonstrate their ability. Many have to acquire this proficiency after they have started graduate work, thus taking valuable time from graduate study to secure knowledge which should have been acquired in undergraduate work. If the utilitarian object for studying French and German is not sufficient, the cultural advantage of knowing such important modern languages may be emphasized. This is one place where an attempt may be made to prepare students for more effective living and at the same time prepare them for possible scholarly work in the future.

The attempts which are being made in some quarters to discourage election of courses in science are unfortunate. It has been said that the study of science is uncultural and that those who teach it are uncultured individuals. To argue such a question would dignify the contention and waste time which might be more profitably spent on more vital problems. To know something of one's own body, or how the water softener in his home works, according to some, is uncultural; to know the idiosyncrasies of Louis XIV or the details of the home-life of King Henry VIII is culture. Lines of demarkation between two such fields cannot, of course, be drawn. The training of a biologist today should be broad in its early years including courses which will make him an interesting person with whom to be. Furthermore, such training will help to enrich his later years and make his life more interesting. Whether this or that subject is cultural depends on many factors such as the definition of the word **culture** and the type of individual. Study of science and especially biological science, may be cultural and give a student interesting hobbies for his later years. It is not only extremely interesting, but cultural to know how nature works for we are a part of it.

The general subject of biology is rapidly disintegrating into parts which are becoming autonomous in their own right. Some of these are assuming important positions because of great practical importance. Notable among the latter are protozoology and bacteriology. These sciences have marked public health significance and have assumed importance on account of it. The latter science, bacteriology, has importance in the field of medicine as well as in the industrial field. For these reasons bacteriology has made a place for itself as a science and will continue to do so. Other fragments of the old subject **biology** are equally important; they will not be discussed here because of the limitations established by the subject. The technic of the bacteriology laboratory is, in general, different from that of the botanical or zoological laboratories. Expensive apparatus and materials are required. Media must be prepared from various ingredients and sterilized before use. Apparatus must be carefully washed and sterilized before use. Such requirements make laboratory work in bacteriology

more tedious, in some respects, than in other sciences. Unfortunately, it also prevents enjoyment of the subject in the field. Inspection trips in bacteriology are limited to water treatment plants, sewage treatment plants or industrial concerns where bacteria are either destroyed or removed, or made to work for man.

Bacteriology may be made most interesting to prospective students. There is no reason, however, why it is a fitting approach to study of some of the great principles of biology. Since bacteria are single-celled micro-organisms they lend themselves quite well to studies on nutrition, metabolism and respiration. In fact some of our knowledge of these functions as they relate to higher animals has been proven with the single-celled organisms. For instance, Neuberg's explanation of the mechanism by which glucose is broken down in the human body was confirmed by results of experiments with pure cultures of yeasts. The single cell is the simplest living entity with which such functions may be analyzed. Refutation of the theory of spontaneous generation was accomplished in experiments with microorganisms. It was demonstrated that organic materials spoiled when they contained a few microorganisms which would develop later. While the theory of spontaneous generation was wrong because it rested on faulty logic and observation, it did much to clarify early knowledge and focus the light of experiment on obscure problems. Those who argued on either side of this question had to have the facts and to systematize them.

Bacteriology has many ramifications into every-day life, some of which I would now like to discuss. It is not just another science for cultivation by university lecturers. It concerns living beings which greatly influence our lives whether they cause disease or whether we use products which they have formed. More useful species are probably known than harmful species. The layman knows only about the harmful species. The reasons are obvious. Pathogenic bacteriology is more spectacular. This is frequently evidenced by the pride and satisfaction exhibited by students who isolate and cultivate their first pathogenic bacterium.

History of bacteriology starts largely with the pathogenic bacteria. While some of the first practical work was carried out on the disease of wine and beer by Louis Pasteur, his interests were soon turned to study of diseases which afflicted man and animals. While Pasteur was working in Paris, Koch, and his colleagues were working in Berlin. The latter investigators soon reported the etiologic agents of some ten of the common diseases which had hitherto been unknown. It was realized that the cause of a disease would have to be known before rapid prograss could be made in its prevention. Progress in treatment has not always followed identification of the etiologic agent of a disease. The first pathogenic bacterium to be isolated was **Mycobacterium tuberculosis,** the cause of tuberculosis. Professor Burrill isolated the first bacterium to cause a plant disease. This was done at the University of Illinois; the organism was named **Bacillus amylovorus.** These discoveries stimulated others to investigate the bacteria as possible causes of other similar diseases. Since then progress has been rapid.

While I have this opportunity, I would like to stress a situation on which teachers of biology may be of great help. By pointing out the value of animal experimentation under the conditions which obtain in American laboratories today, they may have a significant part in helping to thwart attempts to prevent it. Not a year passes when scientists must fight attempts to change our laws making animal experimentation unlawful. Some of us would not be here today were it not for antitoxin. Had animal experimentation not been possible, such products could not have been used and tested. The biology teacher should discuss this problem in such a manner that students will carry away the right opinions. Animal experimentation is necessary and will be necessary in the future in the discoveries yet to be made.

(Continued in April issue)

THE SCIENCE TEACHER

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The Indiana High School Chemistry Teachers' Association
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MOLINE-ROCK ISLAND SPRING MEETING

Illinois chemistry teachers will look forward with much interest to the Spring Meeting coming at Moline and Rock Island April 1. There is a field trip to the United States Arsenal that should prove most interesting in view of the present "mental set" of the Nation; a luncheon with an interesting speaker and a chance to be sociable and get acquainted; and an afternoon program with real "meat" that needs to be thoroughly digested by every teacher. What could be more inviting than a day's program of this type especially when coupled with a suitable day in Spring.

Credit for the program should go to President John C. Hessler of Millikin University who is also president of the association. For the local arrangements at Moline and Rock Island credit goes to Mr. Millard Pratt of East Moline High School and his very efficient local committee.

Illinois teachers must remember that there is nothing any better for professional advancement than to work together in a group such as this and in a meeting in which the "ice is not only broken" but "thawed out completely" and so should plan to be present regardless of circumstances.

INDIANA MEETING

Plans are well under way for the annual meeting of the Indiana High School Chemistry Teachers Association to be held April 14 and 15 at Ball State Teachers' College, Muncie, Indiana. Miss Leda Mae Hughes, secretary of the association reports that some of the features of the program are an address by Captain John T. Taylor of the F. B. I. entitled "The Aid of Science in Criminal Investigation;" a forum on "Possibilities of Visual Education" conducted by Mr. Druley Parker, Shortridge High School, Indianapolis; a dinner Friday night with an address by Professor Frank Graham, Ball Teachers' College; and a trip through Ball Brothers glass jar factory. Several other good numbers are also in prospect. Indiana teachers of chemistry will no doubt begin planning at once to attend a meeting as promising as this.

The Indiana High School Chemistry Teachers' Association is showing a decided growth due no doubt to out standing leadership. This year the Association is ably led by Mr. Charles E. Dilts of Ft. Wayne.

On Being Up To Date

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Good chemistry teachers are progressive. They are eager to keep in touch with all the advances in their field, and to pass them on to their students. More than this, they get a moral and mental satisfaction in doing their best. This spirit of progress is so strong that teachers in large schools do not dare to be complacent or conservative. School boards are very critical toward instructors who are not "up on all the new things," and there is little chance for promotion for a teacher who has a reputation for inertia.

This pressure on teachers to be progressive does not always turn out well. Combined with it is the very unfortunate demand that students must be "entertained," and many times the teacher is forced to compromise his own ideas of scholarship, so as to maintain the appearance of progress. He watches for new things in all easy sources—mainly popular magazines and daily papers—and passes this bizarre and frequently inaccurate material on to his students.

It must be admitted that these changes make the course more interesting and more passable to superficial students. On the other hand, this modernized course is definitely inferior to the older type of course, in which a good textbook and a laboratory manual are used. College instructors are finding it difficult to build advanced courses in general and analytical chemistry on such a foundation. At the University of Illinois, it has been noticed that increasing numbers of students are weak in certain fundamental topics, particularly valence, reactions and calculations.

Valence—Many students enter courses in advanced inorganic and analytical chemistry know little or nothing about valence. They cannot tell the valence of an element from the formula of a compound, nor can they make formulas. They declare that such training was not given in their high schools, or at least it was not stressed.

This slighting of valence may be due, in some degree, to a disbelief on the part of an ultra-modern instructor in the classical theory of valence, with its single, double and triple bonds. Instead of this outmoded theory he attempts to introduce more modern concepts. For example, he shows that the valence of sodium and chlorine in salt may be eitther 0 or 6, certainly not 1, for NaCl is completely ionized, and there is no bond between the respective ions. And, by the time he gets through expatiating on the valence relationships in the CO_3 group, the student is hopelessly befuddled and gives up in despair.

Reactions—A very conspicuous weakness in students coming from schools where the laboratory course is mainly physical is their ignorance of reactions. They remind us of the student in Dr. Slosson's story who knew "the color of neither blue stone nor the black oxide of manganese". They may know how to prepare hydrogen, oxygen and perhaps chlorine, but beyond these the acquaintance with chemical changes is limited. This is particularly true of oxidation-reduction reactions, where little emphasis has been placed upon the products to be expected. Students in qualitative analysis in particular are handicapped if they have not covered the reactions of the ordinary cations and anions in a previous course.

Calculations—A third handicap of students from many schools is that they have not been sufficiently drilled in solving chemical problems. The decadence of mathematics in elementary schools is partly responsible, but college teachers feel that high school teachers might at least cooperate in supplying the training unfortunately omitted. But the principal trouble is, the student cannot set up the necessary equations. Here again the

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Chemistry and Biology in Medical Training

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It is impossible to understand the evolution of medicine without taking notice of the forces which were working upon it from the outside. These may be divided into two groups; the advance of medical education in Europe, and the advance of medical education in the United States.

In Europe the low state of medical development was represented by superstitions inherited from Asia to which had been added the truths discovered by the Egyptians. It rose in Greece with the influence of Hippocrates, sank in the middle ages to the depths of witchcraft and sorcery, rose slightly with the discovery of the circulation of the blood by Harvey, but sank to the depths of despair in the scourges of epidemic disease.

The Chinese had an idea that each mishap was caused by a specific devil. To this our early ancestors added the thought that each disease could be prevented or cured by an individual saint whose duty was to cast the devil out. St. Vitus was believed to control St. Vitus dance (chorea), St. Anthony managed Saint Anthony's fire (erysipelas) and so on through the list. As civilization grew, this notion changed into a kind of childish dream that there would be found a specific remedy or procedure which would cure each separate disease. That dream has not been realized for all diseases but in some instances the goal has been nearly attained. Everybody knows, in this day and age that quinine will cure malaria. Diptheria antitoxin is the remedy for diptheria. Tetanus antitoxin is the preventive of tetanus; cow pox vaccine (vaccination) is the preventive of small pox; emetine (ipecac) often cures amoebic dysentery; rickets and scurvy are cured by certain vitamins; insulin has a specific action in diabetes and thyroid gland is a specific remedy when properly administered in cretinism. In a specific way digitalis is used in treating certain forms of heart disease. Antimony cures many cases of Kala-Azer, and Chaulmoogra oil heals leprosy.

In the thirteen colonies medicine was a business learned by apprenticeship, but often abandoned at the call of a more lucrative opportunity. The practical Benjamin Franklin was a great asset in medical education. The Reverned Cotton Mather defended inoculation with cowpox as a preventive of smallpox.

For the most part the low level of medical accomplishment in America paralleled that of Europe until the science of bacteriology arose.

The early people often thought there was something "good" in the sense of specific for each of the diseases. A list of things which were used as "good" for their ills has been compiled. In the time of Daniel Boone, tallow, lard, turpentine, bear's grease, goose grease, pole-cat oil, whisky, camphor, ginger, honey, linseed oil, Dover's powder, opium, morphine, quinine, charcoal, some iron preparations, maple sugar, snuff, shovel handle tea, vinegar, alum, borax, calomel, epsom salts, castor oil, ginseng, yellow root, spignet, pennyroyal, hoarhound, sassafras, catnip, Indian tobacco, witchhazel, jimpson weed and wilted cabbage were used with fair results. The active principles of these substances were generally harmless, sometimes beneficial, but in some cases dangerous.

During the century following the Revolution a wave of commercial exploitation swept the country's medical education, and medicine colleges sprang up everywhere. Illinois produced thirty-nine, New York forty-three. Cincinnati twenty, and Louisville, eleven. Chicago had fourteen and Indiana twenty-three. The number decreased as time went on.

In many of the early medical colleges there was no laboratory, no janitor, few or no microscopes. There might have

been one cadaver from which one skeleton had been produced. Didactic lectures made up the major part of the course. Empirical medicine was often taught. The same lectures were repeated twice to students who attended two years. Terms were from five to seven months in length. Professors had little time for their students. Many schools existed to pay dividends to their owners. Some schools masqueraded as sectarian schools in order to catch the failures from the "regular" schools. Chairs were considered so valuable as a means of increasing a professor's practice that they were often sold. Such evil conditions prevailed in the United States that protests became so loud commercialism ceased to pay. There was a scampering of proprietory schools to get under the wings of academic control. These evil conditions were in part compensated for by certain virtues developed more rapidly after the Civil War.

In the same smaller towns and throughout the country districts, there were hundreds of practioners who had had only one course of lectures, men who were destitute of the simplest pretensions to science, who were perfectly unable to describe the commonest chemical reaction, or the most essential physiological law; their ideas of hygiene were even below the standard commonly then required of candidates before school boards for positions as teachers. Their knowledge of therapeutics went no further than to a few dozen formulae which accident had thrown in their way, or which they had found in some antiquated volume on domestic medicine. They dosed with a vengeance, and sometimes salivated. Too often calomel was prescribed when quinine was needed. The nature of malaria was not fully understood. Cocaine had been used in South America for centuries and with morphine was commonly used in the United States for relief of pain. But heroine (diacetyl morphine) asperin, veronal, paraldehyde, and a great number of preparations from coal tar were unknown.

With the growth of regular state medical colleges there was no conflict between dogman and science. And such differences as existed between them could not be called differences in creed. A strong feeling had been rapidly growing among the leading members of the profession that the standard of medical qualification should be placed upon a higher plane.

Three hundred years after diethyloxide was made, fully described and widely known someone discovered that when breathed into the lungs it would produce a loss of consciousness and insensibility to pain. Dr. Bobbs had performed in Indianapolis the first removal of gall stones ever done in the United States. It was of course not the first use of an anesthetic (a word devised by Dr. Oliver Wendell Holmes). That perhaps goes back to the famous operation on Adam for the removal of a rib. Later the gentle art of anesthesia was a knock out blow on the head. The wonders produced by the pharmacologist in devising nitrous oxide, chloroform, ethylene and ether have now been forgotten. In some instances they are being supplanted by injection of a low specific gravity liquid, avertin, a trade name for tribromethanol CBr; CHOH into the spinal fluid of a body tipped slightly upward at the feet. Before anesthesia the patient is made ready by use of a soporific, perhaps a particular kind of barbituric acid compound called amytal and having the formula of barbituric acid, 5 ethyl, 5 isoamyl, NH-CO-NH-CO-C-C_2H_5-C_8H_{11}, differing only slightly from the old veronal but proving much more efficient.

The course in medicine had been lengthened from two to three, and then to four years. The session had been lengthened to seven months. The students were required to be present at the beginning and remain the entire term. The requirements for entrance were a college or high school diploma, or a teacher's license. In place of these the student might submit to an examination as specified by the American Medical College Association. Laboratories had been developed not only in anatomy and chemistry, but in physiology, experimental therapeutics, pathology, bacteriology,

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The Pro and Con of Work Books

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This discussion of the workbook is to be limited to the field of physics alone. The search for material to aid in the preparation of this paper has been quite extensive and has led to the same conclusion pupils draw when discussing the fulcrum and place to stand which Archimedes was to use in moving the earth, that is, there isn't any.

This conclusion has also been confirmed by letters from the research department of the University of Illinois as well as from the State University of Iowa. However, there have been quite a few articles written on the apparent value of the workbook, but these are of little importance since they are not backed up by results obtained from correctly controlled and conducted experiments. One study of this type was found and will be discussed later, although it is not in the field of science.

Therefore, it was necessary for me to collect my own data. Questionnaires were sent to 100 physics teachers selected at random from the Illinois School Directory. From these 100 questionnaires, fifty-two replies were received, and from these fifty-two replies some very interesting facts were obtained which are here discussed. One of the questions asked was: Do you use a workbook and laboratory manual, or just a laboratory manual? From this question it was found that no separate workbooks are used at all. Twenty four out of the 52 use manuals alone, while the remaining 28 use the combination workbook and manual.

The second question asked was: How many students use workbooks or manuals in physics? Of the total 1946 reported, 729 used workbooks while 1217 used manuals alone.

The third question was: Is the author of your workbook or laboratory manual the same author as your text? Out of the 28 using workbooks, 19 were not by the same auhtor. This is about 70 per cent. While of the 24 using manuals only 8 were by different authors. This is about 33 per cent. Should they be by different authors?

The fourth and most important question in reference to this discussion was: Give three reasons why you do or do not use workbooks. From the fifty-two replies, thirteen good reasons for and thirteen just as good reasons for not using theme were obtained. These reasons are now presented.

Let us consider the reasons in favor of the use of workbooks.

FIRST: The workbook unifies the course, gives better organization, and furnishes a complete teaching program. It includes material for each of the 5 steps of the unit method of teaching as set forth by Morrison in "The Practice of Teaching in Secondary Schools". These 5 steps are: exploration and guidance, assimilation, organization, application, and re-teaching. Without a workbook no provision is usually made for exploration and guidance, organization or re-teaching.

SECOND: The workbook provides a greater correlation between laboratory work, recitation and testing program. It may even be used as the basis of the course, with text and library books being used as reference. Since it becomes a place for permanent records, it aids the student in reviewing for tests.

THIRD. Again workbooks make an excellent study guide for the student, both for preparation for experiments and recitation. It is so thorough it does not allow one to skip over important details, yet at the same time it covers the whole subject.

FIVE. It is a well known axiom that people learn things by doing them. How can the student follow this axiom if there is nothing beyond the text and performance of experiments for him to do? Repetition is one important method of teaching, and the workbook makes

good use of this method by the amount and character of the drills.

FIFTH. The workbook, due to the available supplementary material, may be used to compensate for individual differences and to keep all students busy during double laboratory periods. There is plenty of work to keep even the best pupil busy while some parts may be omitted for the duller students.

SIXTH. Due to its wide coverage the average workbook requires looking up of facts from other texts, in this way presenting a wider view of all subjects, while at the same time it focuses on the main points. It requires the student to do reference work, and helps him formulate questions. For his reference work it provides bibliographies.

SEVENTH. The workbook is a labor saving, teaching device. It enables the teacher to enrich the course by not requiring so much time for outside preparation. It aids in making assignments and follows a lesson plan for the teacher. Checking of work and outside reading is greatly simplified.

EIGHTH. The workbook saves the student time. If they are not used he must copy either from dictation or from the board long lists of exercises. Or if this work is mimeographed the paper, ink, and teacher's time costs more than a far better workbook. Workbooks do not require long written discussions. This all gives the student more time for reading and learning.

NINTH. By use of a workbook more learning is placed on pupils shoulders since he is furnished with worth while exercises built by experts. Teacher made exercises, unless the teacher is specially trained, are far inferior to workbook drills.

TENTH. The combination workbook and laboratory manual cost very little more than a laboratory manual, at the same time over twice as much useful material is obtained.

ELEVENTH. Pupils like workbooks. They are more convenient for recording data, and for review, it also furnishes him means of checking his own progress with students' self tests. In the study made by Goodrich, 15 to 1 students liked workbooks.

TWELFTH. Workbooks are a great aid to inexperienced, overworked, incompetent teachers. Since they teach themselves, any one can conduct a class.

THIRTEENTH and last. Workbooks provide exercise for "make-up work" after necessary absences. This aids the busy teachers as well as covers the part missed very thoroughly for the student.

On the other hand let us consider the reasons against workbooks.

FIRST. Workbooks are a wholesale waste of time, both for students and teacher. The time required to fill in the workbook could be spent to a greater advantage for the student in discussion in class while the average teachers time is too limited to properly check and grade such a world of material.

SECOND. Workbooks encourage copying. Copying cannot be prevented unless the workbook is used only in class, and this is impossible. They throw a greater burden on the good student as he must prepare the work for himself as well as for the poor student. Try and catch them copying and you have a bigger problem than making out a dozen drills. Students may, sometimes, even obtain teachers key, thus having their work all 100 per cent perfect.

THIRD. A large part of the work in workbooks is just "busy work" or mechanical. The student is forced, due to lack of time, to read his text only enough to answer questions and thus misses the discussion.

FOURTH. Workbooks do not allow students to do independent thinking, neither do they permit self expression or organization. One of the greatest lessons taught in High School is how to study and outline the subject. Certainly with a workbook this lesson cannot be taught.

FIFTH. The cost of workbooks is important. Their cost being much more than texts because of their short life. Besides a manual from 40 to 60 cents while the workbook costs double or more. For a large group of students or very poor

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Model Making as a Biology Project*

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"How can I make my course in Biology more interesting?" This is a ques tion which you, as a teacher of biology, have asked many times.

One answer to the problem is to encourage project work. This may be handled in various ways, and many fields offer an opportunity for expression. Although this article will be confined to model making as a student project, the field is not limited to the making of models alone. Drawings and color paintings of various biological specimens will appeal to the student with a background of art.

This all started in one of Miss Wolf's classes a few years ago when the class made a model of the honey bee as a part of their semester's work. This bee was made to scale and is so complete in every detail, and natural in appearance, that it would be a credit to any professional model maker. The work has enlarged and progressed until, at this time, the Joliet High School has many valuable models made by the modeling groups of the Biology club.

To begin with, the amateur model maker must have tools. Their acquisition need give little concern for the most important tools are the fingers. A few others are handy supplements and these may be made of wood cut to the rough shape with a jig saw or knife, and finished with sandpaper. They should have handles about the size of a lead pencil and working ends shaped like spatulas of various sizes. One or two should have pointed ends. As the student realizes his needs, he will make his tools to fill them. It all makes the work more interesting.

For making simple models, two materials are very suitable, Plasticine and Marblex. The former has a base of linseed oil, and does not "set" for a long period of time, and even then it is not durable. For this reason it is used to make temporary models and master models. From the latter a mold is cast that will produce a permanent preparation of reenforced plaster of Paris.

Plasticine may be used over and over again thus cutting down on the cost. If it is desired to keep a model thruout the semester or the school year, it may be sprayed or painted with white shellac. When this has dried, oil colors may be used to paint in the various structures, thus improving the appearance and increasing the usefulness of the work. When this painted model has served its purpose, it is possible to remove the paint with lacquer thinner, and the shellac with alcohol. The clay can then be worked into a pliable state by adding a slight amount of linseed oil or turpentine.

Marblex is used extensively by the Joliet High School. It has a water base, and when dry forms a very durable model. It can be purchased from the American Clay Company, Indianapolis, Indiana. It is molded and shaped in the same way as plasticine. It must, however, be protected from drying while the modeling is in process. When laid aside it should be wrapped with a damp cloth, and if possible placed in a container which will retain the moisture.

When the marble model dries, it is permanent, and the clay cannot be used again. This is an advantage in many cases. It may be shellacked and painted and then given to the student to take home where he may admire it for a lifetime.

Occasionally a student will produce a model which has more possibilities than just the help and encouragement which it gives to the maker. It may have value to the teacher as a teaching aid and if so, it is desirable to make it permanent, or to make many others like it. When this occurs the plasticine or marblex model may be reproduced in reenforced plaster of Paris. The marblex

* Presented before Illinois Biology Teachers' Association, November, 1938.

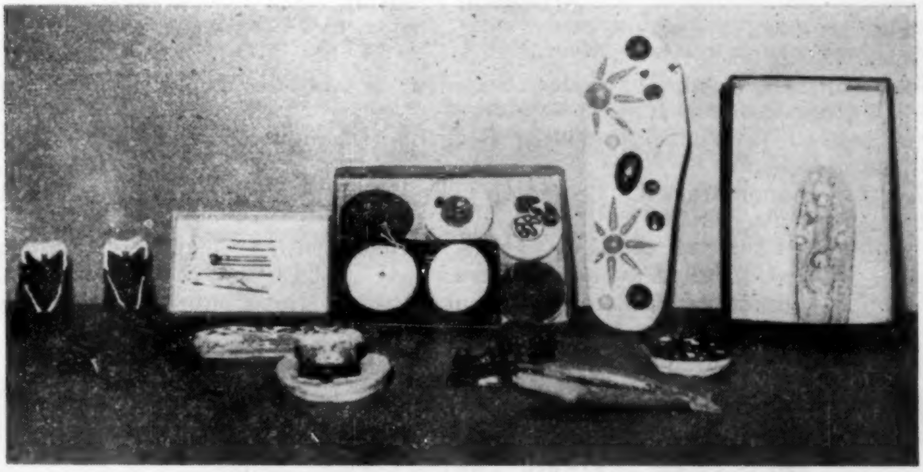
preparation is already permanent in its original form, but rather heavy and clumsy when compared with the hollow reenforced plaster model.

To begin with, material for making a mold must be obtained. There are three excellent preparations. In the Joliet High School the following formula is used:

2 pounds of carpenter's glue.
7 pounds of glycerine.
5 pounds of water.

soaked in water for twenty-four hours, then heated in a water bath and poured when it reaches a liquid state.

The casting of the mold is very simple. Cover the master model with a layer of grease which has been thinned with kerosene so that it can be applied with a brush, and place in a similarly greased tin container slightly larger than the model. Pour the molding material into the container so as to submerge the model. After it has thoroughly cooled



Soak the glue in the water for several hours, add the glycerine, heat in a water bath, and pour while hot.

At the University of Michigan, Mr. R. Hollitz uses Korogel, which may be obtained from The National Gypsum Company, Chicago, Illinois. This is a rubber composition which must be melted over Crisco—the same Crisco that is used in the kitchen at home. Merely substitute Crisco for water in the water bath when melting Korogel. This rubber mold has the advantage of being permanent. The glue and glycerin molds will decompose after a few days. Also, the rubber mold may be ground in a food copper when you are finally through with it, and used many times over. Mr. Hollitz estimates that he uses the same Korogel for twenty molds.

Some professional model makers use molding gelatin or sheet gelatin. The former may be purchased at any builder's supply company. Gelatin must be

and dried, separate the model and the container from the mold. The impression of the master model is now recorded in the mold.

Before using the mold for casting the final model, it should be brushed with a saturated solution of alum. When this has dried any excess should be removed by dusting and brushing with talcum powder or french chalk (just like a floor is covered with compound and swept clean). Be sure to use a soft brush. Finally the mold is given a coating of thin grease just as the master model received.

Plaster of Paris, thinned to workable consistency, is now applied to the mold by snapping the plaster from the ends of the fingers. This forceful application removes air bubbles and insures application in every crevice. After the exposed surface of the mold is thoroughly covered strips of loosely woven gauze soaked in wet plaster of paris should be applied

(Continued on next page)

PROGRAM
ILLINOIS ASSOCIATION OF CHEMISTRY TEACHERS
Augustana College, Rock Island, Illinois
April 1, 1939

Morning

Field Trip to United States Arsenal. Meet at Moline High School at 10:00 a. m.

Noon

Luncheon at Augustana College.

Cost will be 60 or 65 cents per plate. Send in your reservation to Mr. Carl E. Ekblad, Moline High School, by Friday, March 31.

The speaker for the luncheon will be some one from the arsenal.

Afternoon Program

Place: Augustana College.

Time: 2:00 p. m.

Chairman: Dr. John C. Hessler, President of Millikin University, Decatur, Illinois.

"Address of Welcome" President Bergendorf, Augustana College.

Business Session.

"Lecture Demonstration," Professor J. P. Magnusson, Department of Chemistry, Augustana College.

"Luminous Paint," Professor Googins, Department of Chemistry, St. Ambrose College, Davenport, Iowa.

Panel Discussion of the topic: "What Shall be the Content of the High School Chemistry Course?"

Discussion Leader: Carrol C. Hall, Springfield High school.

1. "Consumer Chemistry in the High School," Professor R. W. Fogler, Normal University, Normal, Illinois.
2. "How Much Mathematics in High School Chemistry," Dr. Norvill Beeman, Oak Park Township High School.
3. "Physical and Chemical Science 'Fusion' Courses," Mr. Theodore Nelson, Decatur High School.
4. "Obligations of High School to College Chemistry Course," Dr. Nicholas D. Cheronis, Wright Junior College, Chicago.
5. "Why Teach Chemistry in the High School," Dr. John de Vries, Professor of Chemistry, Knox College, Galesburg.
6. Discussion between members of panel on each topic and then, at the close of the entire panel, discussion from the floor.

The local Committee in charge of arrangements:

Mr. Millard Pratt, Chairman, East Moline High School.
Mr. Carl E. Ekblad, Moline High School.
Mr. George Baird, Rock Island High School.
Professor J. P. Magnusson, Augustana College.

Note: Illinois chemistry teachers should send their $1.00 annual dues to Mr. S. A. Chester, secretary-treasurer of the Illinois Association of Chemistry Teachers, Bloomington High School. All paid up members receive The **Science Teacher** without any additional cost.

MODEL MAKING

as reenforcement. Following the wet gauze, dry gauze or ground cork may be placed in the mold. This will give the effect of a hollow center—lightness and strength. The back of the model should then be closed with gauze soaked in plaster.

When dry, or nearly so, the model should be removed from the mold and the fine details emphasized by sculpturing with a sharp tool, such as, a scalpel.

(Continued on page 18)

Testing Wool---A Chemistry Project

JOHN C. CHIDDIX

Community High School Normal, Illinois

We usually think of woolen clothing in relation to cool weather and the winter season. We want woolen sweaters for outdoor work and sport, wool gloves and sox for warm hands and feet and wool suits and dresses for winter comfort. But it also has its place in summer wear. For warmth, strength, and wearing qualities at a reasonable price it has no equal. We may be amazed to learn that a half billion pounds of wool are used annually in the United States in the production of clothing, rugs and similar materials.

Since we desire wool in much of our clothing and are willing to pay liberally for it, we need to know something of its properties, be able to recognize and test for it that we may insure for ourselves honest values.

How It Appears and Its Properties.

Good wool has great strength and when rightly woven into cloth produces a very strong fabric. Its strength varies with the size of the fiber and the part of the sheep from which it was taken. It even varies with the sheep as to whether the sheep was well fed and cared for or not. Wool is very elastic as may be observed by simply squeezing some in the hand and releasing it, a property which causes woolen cloth to hold its shape well and not wrinkle readily. It also permits wool to give under strain without breaking and to maintain the myriad of air pockets in the cloth that makes this type of fabric so warm. The dead air spaces in it greatly reduces the loss of heat from the skin.

On the surface of most kinds of wool fiber are tiny scales, somewhat like the scales on fish, but of a gelatinous composition. These cause wool to feel rough to the touch. Should the fibers be strongly pressed together, especially when moist and hot, the scales catch upon each other and hold together rather permanently. It is this characteristic feature of short wool that enables felt to be made from short fiber wool.

Wool is quite hygroscopic. It slowly absorbs moisture from the air and holds it within its fiber, often greatly increasing its weight. Usually it will contain about 15 or 16 per cent of moisture, but in very damp weather the moisture content may be as much as 30 to 50 per cent. Heavy wool clothing then really does become heavy. The presence of excessive moisture reduces somewhat the heat holding value of the cloth.

Types of Wool Fibers.

New Wool: Wool varies widely in length and character even from one sheep. Quality is also affected by the food given the animal, its care, health, the severity of the winter, and many other factors. The length of fiber varies with the breed of sheep. That of the Morino raised in the U .S. is among the shortest and averages only about 2 1-4 to 2 1-2 inches in length. On some breeds it is over 10 inches in length, the longer types usually being more hair like. The appearance ranges from dull as on the Morino sheep to quite silky on the Leicester sheep of England.

Shoddy Wool: If only new wool were used in making cloth, there would be a great shortage in this type of clothing. Not enough is now available to provide everyone with a single suit. So in order to increase the amount of woolen cloth, old woolen clothing is torn into shreds, the fibers obtained and reworked into cloth.

In recovering wool from a mixed cotton and wool cloth the cotton is destroyed by carbonizing it with H_2SO_4 or other agent. The severe chemical treatment often affects the wool, removing scales from the suface and corroding the fiber.

Some of this shoddy wool is quite serviceable while other portions are of doubtful quality and consequently make cloth of less value. However, the mixing of any type of shoddy wool with cot-

ton to give strength gives a serviceable and fairly warm fabric.

Tests (for wool).

Microscopic: Under the microscope wool fibers usually are covered with tiny overlaping scales somewhat like those of a fish. In some fine wool a single one encircles the fiber, giving it the appearance of a collapsible drinking cup or a series of funnels slightly tellescoped inside each other. In other fibers, particularly the coarser ones, two or three scales may encircle it. The scales on hair fibers are more difficult to see, are more closely joined to the hair fiber and do not show open or serrated edges.

The luster of wool depends on the kind and arrangement of these waxy scales. When they are set firmly to the fiber and are smooth, horny, regularly arranged they show the greatest luster.

By focusing the microscope down deep into the wool fiber, sometimes a canal, known as the medullary canal, may be seen. It may look somewhat like a line or a series of cells and may appear to be composed of granular material. In hair fibers the medullary is usually visible. This canal is very important in the dyeing of wool as through its capillary action probably much of the dye is absorbed. Wool in which the canal is clogged does not dye evenly. Shoddy wool, which of course is the fiber recovered from old cloth by tearing it to pieces in machines, often has the scales on the fibers damaged or even stripped from them. However, damaged scales as seen through the microscope cannot be relied upon as a sure indication of reworked wool as new wool may be damaged in the process of manufacture. Other indications are frayed ends of fibers torn in the process of recovery, fibers that vary in size and general appearance as a result of coming from various sources, and especially an occasional cotton fiber which shows the wool was recovered from a cotton wool mixture in which the cotton was not completely destroyed in the carbonizing process. The ends of the fibers sometimes become frayed in the process when it is recovered from mixtures of wool and cotton by carbonizing the cotton with H_2SO_4.

Chemical Tests. Composition: Wool is protein in nature as are all other animal fibers. It is composed of C, H, O, N, and S. The last two elements distinguish it from cotton, linen, and rayon which are cellulose products and contain C, H, and O. So to distinguish wool from those vegetable fibers it is only necessary by tests, to show the presence of N and S. It differs from silk, also a protein fiber, by containing S which is not found in silk except as an impurity resulting from weighting it with some sulfate salt.

Burning: Burn some woolen cloth in a dry test tube. The odor is like that of singed hair or burnt feathers. Insert into the tube some filter paper wet with a lead acetate solution and note the appearance. The black color produced on the paper is due to the presence of S which reacts with the lead to form lead sulfide, PbS, a very black compound. The black color of the incompletely burned residue is due to carbon in the fiber. Insert into the tube a wet piece of red litmus paper or a drop of concentrated HCl. The litmus paper should turn slightly blue due to the formation of ammonia, NH_3, from the N and H of the protein. Concentrated HCl will produce a chemical smoke of fine particles of NH_4Cl produced by the union of NH_3 from the protein and the HCl gas from the acid.

Reaction With Acids and Bases: Place some wool in concentrated H_2SO_4 and heat. The fiber dissolves quite slowly. Repeat with concentrated HNO_3 It turns yellow as does other protein matter and slowly dissolves. Concentrated HCl scarcely affects it. Place some wool in a strong (50 per cent) sodium hydroxide solution and watch results. The fiber is quickly destroyed. In a boiling solution of this base the fiber is destroyed in about 5 minutes.

Color Reactions: Color tests are useful in the case of light colored material. Dark shades must first be bleached in a strong peroxide solution.

Nitric Acid. Place some of the fibers in a strong nitric acid solution. It turns

(Continued on page 19)

MEDICAL TRAINING

(Continued from page 7)

bandaging, and surgical dressing, and methods of physical, microscopic and chemical diagnosis. These new methods of diagnosis were good because they were independent of the personality of the patient or physician.

Antiseptic surgery and sanitation was established. The operator worked in a spray of carbolic acid. They also used carbolized gauze and a dressing. Later it was found the spray was unnecessary and the chief precautions to be taken were sterilization of the instruments, their hands and body of the patient. The efforts toward sterilization in the hospital produced surprising results, but were met with much skepticism by the local profession and even by some of the surgical professors of the Medical Colleges. However, the nurses at the hospital were all taught these methods and thoroughly believed in them. They, therefore, would get a patient antiseptically ready for operation even if the operator was not convinced of its usefulness. Some of these doctors derided the idea that there were "little bugs" about. However, they had no objection to the nurses' sterilizing the instruments, saying "yes, you may boil them. It never does any harm to be clean." The following is a story told by Dr. Charles Furgeson of Indianapolis. Two cases where amputation was necessary were before the student body for demonstration. The demonstrator of these two amputations was an experienced professor in surgery from one of the local medical colleges. Before he had made his preparations, Dr. John Oliver, who was his young assistant, and was convinced of the benefits of antiseptic surgery stepped up to him and said, "May I not perform one of these operations by the antiseptic method in order to convince the students of its usefulness?" He was granted the permission, and the two amputations were completed, one by the professor, the other by the assistant. One week later at the next weekly Saturday surgical clinic the two patients were rolled out to the demonstrators' platform in front of the students' amphitheater. The professor of surgery was pleased when he had uncovered his own operation and found the wound had been dressed daily and was covered with what he called in those days "laudable pus". On uncovering the work that had been done antiseptically by the assistant no pus at all was discovered, and the wound had begun to heal. This was the first time that the professor of surgery had known a wound of this kind to heal without pus, and he was still further surprised to learn that the original dressing of the day of the operation had not been disturbed.

(Continued in April issue)

ON BEING UP TO DATE

(Continued from page 5)

trouble seems to be insufficient training in reactions.

The situation may be further complicated by the weakening of the instructor's faith in some of the older doctrines of the science. To be sure, the law of definite proportions is incompatible with the existence of isotopes. X-ray analysis has shown that occasionally oxygen atoms are lacking from the lattices of lead dioxide and maganese dioxide, so that their compositions only approximate the formulas PbO_2 and MnO_2. The extension of the principle of reversibility to reactions in general shakes his faith in the calculation of stoichiometric relations. If the instructor confides doubts like these to his students, there is no wonder that they take small stock in calculations.

If the teacher is to give more time to valence, reactions and calculations, he must make place for them by omitting other things, and the college teacher is impudent enough to suggest certain topics. These omissions are, in general topics that are either beyond the ability of the beginner, or else fads of undetermined educational value. The first group may be illustrated by the emphasis that some teachers put on atomic structure. They parade before their classes hydrogen and helium nuclei, electrons, positrons, neutrons, neutrinos, anti-meutrinoes; they expound octets and orbits, and maybe make some suggestions about

(Continued on page 18)

ON BEING UP TO DATE

(Continued from page 16)

transmutation of the elements. The abandon with which these things are presented to beginners is amazing to university professors who reserve the whole subject of atomic structure for their advanced mathematics and physics. Another subject that cannot be satisfactorily treated in beginning courses is the Debye-Huckel theory of complete ionization. A very natural inference for an immature student is that the whole doctrine of ionic equilibrium is being questioned. Colloids, Werner's theory, stereo-isomerism, and other difficult topics are better ommitted in favor of more time for drill on elementary subjects. The introduction of organic chemistry into the introductory course is frowned on for another reason: It is very difficult to articulate such a course with established college courses.

Elementary students should be taught elementary chemistry, not college chemistry.

MODEL MAKING

(Continued from page 12)

Air bubbles and other flaws can be filled in by applying wet plaster by means of a small brush.

It may take a week or two before the model can be painted as the cast must be thoroughly dry. A coat of lacquer or shellac should be applied first. After that the various structures may be colored with oil paint, to be followed by a protectiye coat of shellac.

The methods described are applicable to simple models of Ameba, Paramecium, Stems, Leaves and others which have unfinished side on which the model stands. For models that have their entire surfaces sculptured, two molds must be made and the two held together while the two halves of the wet model set to form a single unit. All of the details of this process cannot be given here, but it is interesting work for those students who have succeeded with the simple models and are looking for new fields to conquer.

TESTING WOOL

(Continued from page 15)

yellow. Vegetable fibers do not. If the treated fiber is moistened with ammonia, the color deepens to orange.

Lead Acetate: Boil the sample of cloth in a 5 per cent solution. When wool is present a black color develops due to the presence of S in the fiber. Silk gives no color under these conditions.

Millons Reagent: This reagent is useful in testing for protein material. It is made by allowing 10g of mercury to react with 7cc of concentrated nitric acid having a specific gravity of 1.4 until the reaction ceases and then adding 14cc of distilled water.

Wet some wool material with Millon's reagent, made as just indicated and warm slightly. It should turn yellow. Repeat the test using cotton. It will be found that vegetable fibers are not colored.

Fuchin: The dye prepared by neutralizing a 1 per cent fuchin solution with NaOH until a precipitate just begins to form and then filtering. Place a sample of wool in the solution and heat it to the boiling point. Then rinse the sample in water containing acetic acid. The wool will be colored pink. Cellulose fibers are not colored.

Acid Dye: Any acid dye is readily absorbed by wool but has little effect upon cotton. Upon washing the latter, nearly all of the dye is removed. The dye bath may consist of a 1 per cent soluction of an acid dye to which may be added some Glauber salts and a few drops of H_2SO_4 to render the solution acid to litmus paper. The sample of cloth should be heated to boiling in the bath and then washed well in clean water.

Mikado Yellow: To a 1 per cent solution of the dye should be added some Glauber salts and a small amount of sodium carbonate to render it basic. Place the wool sample in the bath and keep the temperature at 50 degrees C. for 30 minutes. Wash well in clean water. Wool is scarcely colored.

WORK BOOKS

(Continued from page 9)

students this increase in price is a great factor.

SIXTH. Workbooks do not meet individual needs. Much of the material is too juvenile. It does not keep the good student busy, since it does not keep him interested. Besides, workbooks only require students to fill in blanks instead of learning science.

SEVENTH. Workbooks are not adaptable to varied needs of various pupils since they cannot be shortened without leaving out entire sections. They require all students to do too much outside reading and reference work.

EIGHTH. The workbook is absolutely unnecessary. Every modern text contains sufficient problems and exercises, which if properly worked will keep even the best student busy. With a workbook these have to be omitted for lack of time.

NINTH. Some schools have a fixed course of study or a text which cannot be changed. For these it may be impossible to find a workbook which will correlate with them. Thereby mixing the whole course up and requiring more time for assignments than would be saved by the workbooks.

TENTH. Workbooks contain too much wasted material. There is too much repeating, the whole subject cannot be covered in 9 months. Self tests for the student are seldom used and if they are then the other parts are useless.

ELEVENTH. The library facilities of the average high school are too meager to allow a student to do extensive reading or research along interesting lines. Texts written after years of experience should be followed instead of some new idea that hasn't been in use long enough to know whether it is worth while or not.

TWELFTH. Bookselesmen claim workbooks are a panacea for all educational ills. But the old medicine doctor claimed the same for his patent medicine. If he was right, then so is the salesman.

THIRTEENTH, and last. Workbooks are not a "teaching device". They curtail experienced teachers initiative, and give the lazy teacher a chance to loaf. They tend to reduce teaching to a mere routine and stand in the way of his growth.

After summing up the points on both sindes one can easily see both have their strong points. It seems to me also that it is not a question of cost or anything else except a question of "do they increase pupil learning?" This question cannot be answered by discussion alone We need to study the results obtained by their use. Such a study was conducted by Dr. Ira O. Scott in the Garden City Kansas High School. Twelve classes were divided into three groups each.

A Group was to use text alone.

B Group was to use text and workbook.

C Group was to use workbooks alone.

The grouping was done by the mental age method. Each group was given the same preliminary teacher-made test at the beginning of the term, then the same test was given again at the end of the term.

The results obtained were very confusing. Five classes showed gains for groups using workbooks alone. Four showed gains in favor of text book alone, while three showed gains in favor of both text and workbook together. Not being satisfied, Dr. Scott examined twenty other studies. Eleven (four of which were science)showed differences in favor of workbooks alone while six (2 of which were science) showed differences in favor of the text. Three groups showed no differences.

Considering the 11 in favor of workbooks and 6 in favor of text, there seems to be not enough differences favoring either method to be able to draw a conclusion.

Therefore, until carefully controlled experiments are conducted which do prove favorable to one side or another, I say, if you like workbooks and believe they aid the student, then use them, if you don't, then don't use them.

BOOK SHELF

CHEMISTRY AND YOU. Hopkins. Davis, Smith, McGill and Bradbury—Lyons and Carnahan, 1939. Pp. ix 802.

It is a rare opportunity when an individual who has seen a book grow from a few pages of manuscript to a completed edition has the privilege of reviewing it.

Throughout the whole writing and editing of this outstanding high school chemistry textbook the workers on it have been reminded of the ideals and educational aims of its publishers: the insistence on scientific accuracy, the inclusion of the most recent developments in chemistry, a sound pyschological organization, as usuable reading vocabulary, the best technique in illustrating, the preserving of the consumer point of view for purposes of a general education. an emphasis on the basic principles of the science, practical reference and problem materials, and self-study exercises that are planned not only to aid in learning but also designed to sustain interest. All these fine features gathered together and made personal in an 'individualized' textbook.

Organized into sixteen (16) complete and comprehensive units this text gives a basic, fundamentally sound, elementary chemistry course. The working tools and fundamental concepts needed by the chemistry student are developed in an intelligent and educational manner in the first units so that by the end of the first semester's work the descriptive material that is to follow in the succeeding units will become more meaningfull and comprehensible.

A sincere attempt has been made to improve the offerings of the second semester. Instead of the usual, monotonous, cataloging of the elements of the periodic table the unit idea has been carried through. This has resulted in a well-balanced textual arrangement that assures the teacher who uses it a complete course of study.

One new and unusual feature of the text is the inclusion of a unit on 'Your Health'. This gives material on a much-needed development of Bio-chemistry for the high school level. By this means the work in organic chemistry is definitely linked to the vital life processes.

Within the organization of the individual units one is impressed by their completeness. Teaching cannot be one-sided when done from this text. Each unit introduces, then builds up step by step the desired factual knowledge, the chemical principles and generalizations, then, reviews and questions to more firmly fix the desired learnings. Finally, the 'big ideas' are reviewed showing the relationship of one unit to the other and, incidentally, the relationship of the materials of the unit to the life of the pupil.

The text has for its purpose the making of every chemistry instructor 'a Master Teacher.' The learnings common to all texts are presented in new and interesting ways. To aid the teacher in presenting the more difficult fundamentals; such as, the newer theories and concepts, especial attention has been given to their development. Not only is the textual material pointed to that end but suitable diagrams, outlines, and other illustrations are provided.

You are invited to inspect this new, sound, and attractive high school chemistry textbook. This invitation should be particularly welcomed by those teachers who plan to do outstanding work in the secondary field.

CARROL C. HALL,
Instructor in Chemistry,
Springfield (Ill.) High School

A Teacher's Manual for DISCOVERING OUR WORLD, Book Two, by Wilbur L. Beauchamp (University of Chicago), Glenn O. Blough (Laboratory Schools, University of Chicago), and Mary Melrose (Supervisor of Elementary Science, Cleveland). 120 pp. January, 1939. Scott, Foresman and Company, Chicago. Free to users of DISCOVERING OUR WORLD, Book Two; 24c List to non-users.

Desirable scientific attitudes are not caught from out of thin air, rather they are the result of careful teaching and of practice acquired through the development of a series of well planned exper-

(Continued on page 24)

BOOK SHELF

(Continued from page 22)

iences. Teachers in the middle grades should welcome then a handbook which is designed to guide them in their approach to fifth grade science and help them achieve the most from the time and materials available. Such a handbook is the recently published Teachers' Manual to accompany the scarcely six-months-old fifth-grade science book, DISCOVERING OUR WORLD, Book Two.

Those acquainted with the increasingly popular DISCOVERING OUR WORLD books know that these are science books based on the thesis that science to be useful must function as a method of thinking and behaving. Written mostly in terms of pupil activity, their approach is psychologically sound because they begin with the child where he is and lead him to make generalizations from the results of his own observations and experiences in solving environmental problems. The course is so planned that the child gets enough practice in the application of principles to make them permanently functional.

Fortunate for teachers, Dr. Beauchamp and his colleagues seem to be aware that good materials comprise only one phase of a good science course—that the objectives of science teaching and the way the teacher goes about achieving them are of vast importance. In the manual which they have prepared, the philosophy of modern science teaching is lucidly outlined in a very meaty chapter entitled "Modifying Behavior Through Science." This section alone should make the Manual a **must** for every elementary science teacher. Particularly helpful also should be the material on "fitting the course to local conditions," suggestions for getting the most out of a science course, whether it be a part- or full-time course.

Teachers who find equipment for experiments a problem and who appreciate helpful suggestions in getting the most out of each day's work will recognize the value of this manual.

Our Physical World. Definite progress has been achieved in a unified course in physical science for the senior high school in the new text, "Our Physical World," by Eckles, Shaver and Howard, published by Benjamin H. Sanborn and Company. The text treats the natural, challenging, and vital scientific factors of the students environment in a very realistic way and in keeping with the newer approach to science study. If we may glance at only two of the units, "Science Changes Our Environment" and "The Control of Scientific Achievement" we are at once impressed not only with the presentation of scientific theories and facts but also with the analysis of their social implications.

Its objectives are to present the physical sciences as an integrated field of knowledge much as has been done in general biology; to present the physical sciences in a truer perspective than has been possible when chemistry and physics have been taught as compartmentalized subjects and to reveal the significant social implications of the amazing increase of scientific knowledge.

Its content in brief are centered about the fundamental character of energy and matter with no attempt to segregate the chemical aspects from those commonly taught in physics; man's application of scientific laws to problems of industry, health and personal comfort; the scope and nature of the universe and the place of the earth within it; and the history of the earth, its internal structure, its surface, and how these are related to man's existence.

One of the many appealing features of the text is the possibility it offers for laboratory and demonstration work. This phase of science is recognized of great value to true understandings and concepts, the foundation for the "big ideas" in this field.

The book is well bound, and has an acid resistant cover. The type used makes it easily read. It is well illustrated. 801 pages. Price, $2.20 list.

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